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MODEL 306A CABLE CARRIER TEST SET

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Figure 1. Anaconda 306A Cable Carrier Test Set.

1. GENERAL DESCRIPTION

1.01 The Anaconda 306A Cable Carrier Test Set (Figure 1) is a multi-purpose instrument for use in the installation and maintenance of Frequency Division Multiplex (FDM) cable carrier systems in the 5 kHz to 152 kHz frequency range. Its capabilities include: (1) measurement of dc cable pair voltages (0 to ±350 Vdc), (2) dial-up and measurement of Voice Frequency (VF) (800 Hz – 15 kHz) test tone levels (–19.9 to +9.9 dBm) and (3) selection and measurement of carrier frequency 5–152 kHz levels (+9.9 to –49.9 dBm). Testing of carrier systems can be performed with a 306A anywhere along the carrier line, at Repeaters, or at Subscriber Terminals where the VF signals are separated and distributed to the individual subscriber instruments.

1.02 A typical FDM or analogue carrier system (Figure 2) consists of a CO Terminal, non-loaded cable pair (with Repeaters as required), and Subscriber Terminals. Repeater spacing is usually at nominal 35 dB intervals. The 306A is connected to any test point in a cable carrier system by using the "universal" five-way alligator clips and attached cable. The test set provides dial-up capability through clip-on (cuff-link) terminals where a dial handset (butt-in) can be connected. (No dial-up when on Carrier Line).

LED DISPLAY

1.03 A five-digit LED display (Figure 3) provides a visual monitor of seven separate measurements which are selected by the Function Selector switch (Figure 4). The display flashes to warn that the batteries should be recharged. When the 306A is not tuned to a valid carrier signal, an "off-frequency" condition is indicated in the display by the presence of an additional or leading decimal point. The indication is active only in the READ and LEVEL positions of the Function Selector switch.

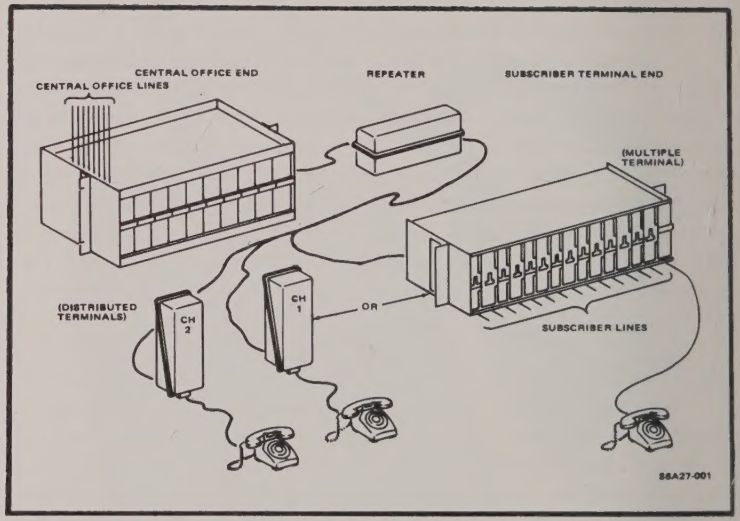


Figure 2. Typical Station Carrier System.

1.04 The CXR BRIDGE functions are DC VOLTS, TUNE (kHz) (carrier frequency being tuned), READ (kHz) (actual carrier frequency being monitored), and LEVEL (dBm) (level of the carrier). The VF functions are TUNE (kHz) (test frequency being tuned), READ (kHz) (actual VF frequency being received), and LEVEL (dBm) (level of the VF tone being received).

1.05 DC VOLTS. With the Function Selector switch set to the DC VOLTS position and the test set connected to any line, a dc voltage up to ±350 Vdc can be measured. The dc voltage can be read directly on the display.

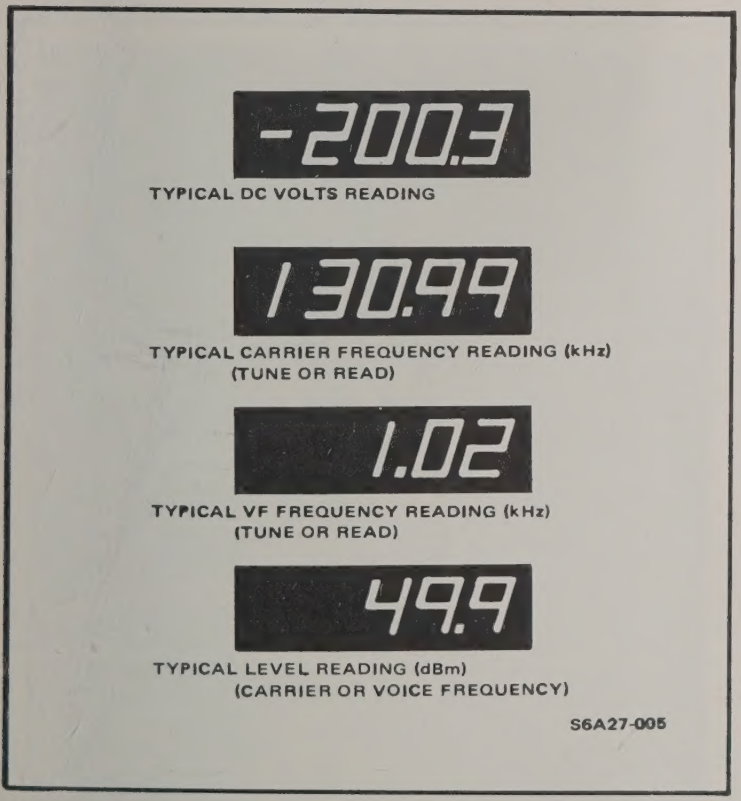


Figure 3. LED Display

1.06 TUNE. Carrier frequencies from 5 kHz to 152 kHz, or VF from 800 Hz to 15 kHz can be tuned with the 306A. When the Function Selector switch is set to the TUNE position, a desired frequency may be manually selected using the dual speed TUNE control. Tuning is

Figure 4. 306A Controls and Front Panel.

accomplished by changing the frequency of the internal oscillator while monitoring it on the display. The TUNE control operates in coarse steps, with variable fine tuning between these steps. The actual carrier frequency or VF is displayed when the Function Selector switch is set to appropriate READ position. This closes the phase-lock loop which "locks" the 306A onto the actual frequency, when it is within a "capture" range of ±500 Hz of the tuned frequency.

1.07 LEVEL. With the Function Selector switch set to the CXR LEVEL position, carrier frequency levels from −49.9 to +9.9 dBm can be read in the display. When the Function Selector switch is set to the VF LEVEL position, VF levels from −19.9 to +9.9 dBm can be read.

1.08 DIAL. When using the 306A with a lineman's test set (butt-in), line dial-up can be accomplished by setting the Function Selector switch to the DIAL position. A 25-milliampere dc current is maintained on the circuit to hold the dialed line and enable testing. When the Function Selector switch is set to any of the HOLD positions, a constant current load of 25 milliamperes is placed across the line under test.

1.09 LOUDSPEAKER. A loudspeaker and VOLUME control are contained in the test set. They allow the user to audibly monitor signals and line noise. They also aid in tuning the instrument. An audible tone will be present, during tuning the 306A, when nearing a VF or carrier frequency. This tone decreases in frequency until it reaches a null point. This null indicates a valid carrier frequency or test tone. By using this audio "zero-beat" tuning method, the craftsman can quickly accomplish proper tuning of the test set. After tuning is completed, the Function

Selector switch must be set to the READ position to read the actual incoming frequency on the display.

2. PHYSICAL DESCRIPTION

2.01 The Anaconda 306A Test Set is a miniature, hand-held, battery-operated instrument. Special features include an LED display, built-in loudspeaker, and a provision for line dial-up using a dial handset with clip-on terminals.

2.02 The LED display, Function Selector switch, TUNE and VOLUME controls are located on the front of the test set. A test cable, with "five-way" alligator clips, is permanently attached to the upper end of the instrument. Terminals for connecting a dial handset are located at the lower end of the test set.

2.03 The 306A is powered by ten, size —AA, nickel-cadmium, rechargeable batteries that provide up to eight hours use between charges. The batteries are recharged through an external charge jack (9, Figure 5) using the 306B transformer/charger (optional feature).

2.04 Operating controls and indicators are shown in Figure 5 and described in Table 1.

TABLE 1. Operating Controls and Indicators.

Index No.	Name	Function
1	Function Selector Switch	OFF position disconnects battery power from test set. DC VOLTS position permits measurement of dc voltages. (CXR) TUNE position conditions test set for tuning to a desired carrier frequency (as shown by the display). (CXR)READ position conditions the test set to display the actual carrier frequency which has been tuned. (CXR) LEVEL position enables the test set to measure and display the level of the carrier frequency which has been selected. DIAL position permits use of a dial handset to dial up a test line for level measurements. HOLD positions are used for holding a dialed-up line for VF testing. (VF) TUNE permits tuning and holding a selected VF test tone. The frequency being tuned will appear in the display. (VF) READ. The test set will display the actual VF frequency being measured. (VF) LEVEL. The test set will display the level of the VF tone being measured.

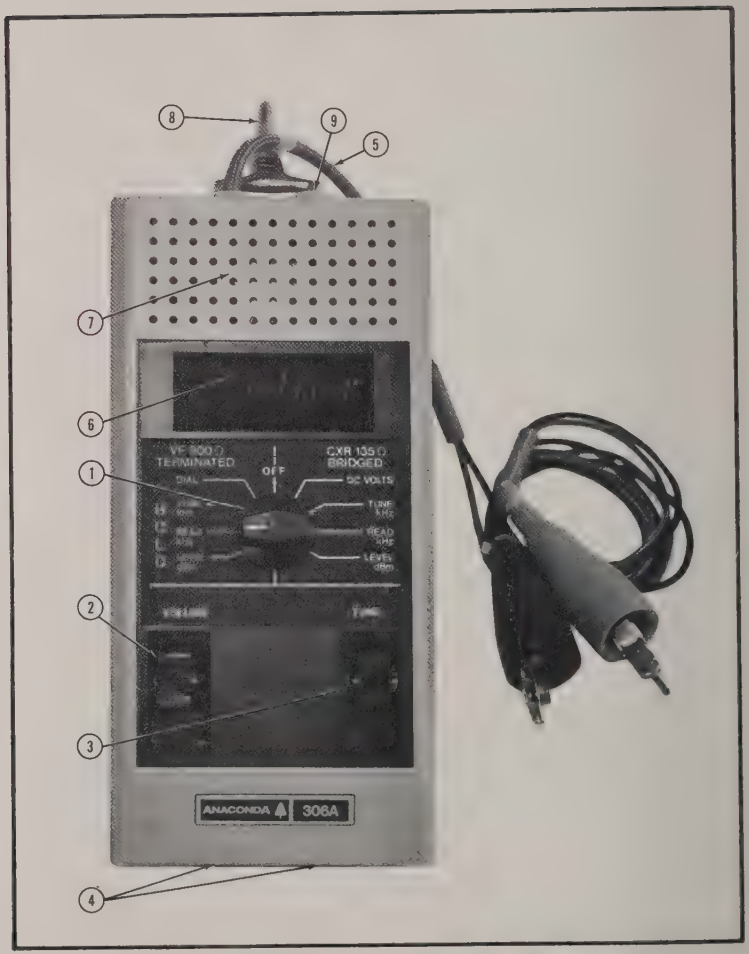


Figure 5. 306A Operating Controls and Indicators

TABLE 1. Operating Controls and Indicators.(continued)

Index No.	Name	Function
1 (cont'd)		**NOTE** All switch positions applicable to VF tests are designated by orange letters on the test set front panel.
2	Volume	Controls the audio level to the loudspeaker*.
3	TUNE (frequency selector)	Selectively tunes carrier frequencies or VF.
4	Clip-On (Cuff-Link) Terminals	Provided for connection of a dial handset using standard test clips. (not shown)
5	Test Cable	Permanently attached cable with test clips for connection to carrier or VF lines.
6	Display	Five-digit display for readout of level or frequency as determined by the Function Selector switch setting.
7	Loudspeaker	Monitors the VF signal or audible "zero-beat" in the TUNE mode.

TABLE 1. Operating Controls and Indicators. (continued)

Index No	Name	Function
8	Belt Clip	Permanently attached, foldable belt clip.
9	Battery Charger Jack	Connection for external Model 306B Transformer/Charger. To charge batteries, Function Selector switch must be set to OFF.

* When the need for audio monitoring is not required, the volume control should be turned completely down to avoid excessive battery drainage.

3. FUNCTIONAL DESCRIPTION

3.01 The 306A circuitry consists of a protected input circuit, a phase-locked VCO–IF tuning loop, an A–to–D converter, auto-ranging circuits, and a microprocessor (Figure 6).

3.02 In all of the Function Selector switch positions, except DC VOLTS, the input signal is capacitive-coupled to a voltage limiter. This limiter provides protection to the test circuits. It also provides dc isolation from circuits under test. Nominal input impedance for carrier frequency measurements is 4k–Ohms, with readings calibrated for 135–Ohm carrier lines and 900–ohms for VF lines. Input signals are applied to the mixer/IF through a 160–kHz low pass filter. The DC VOLTS circuit provides a high impedance (100k–Ohm) isolated input.

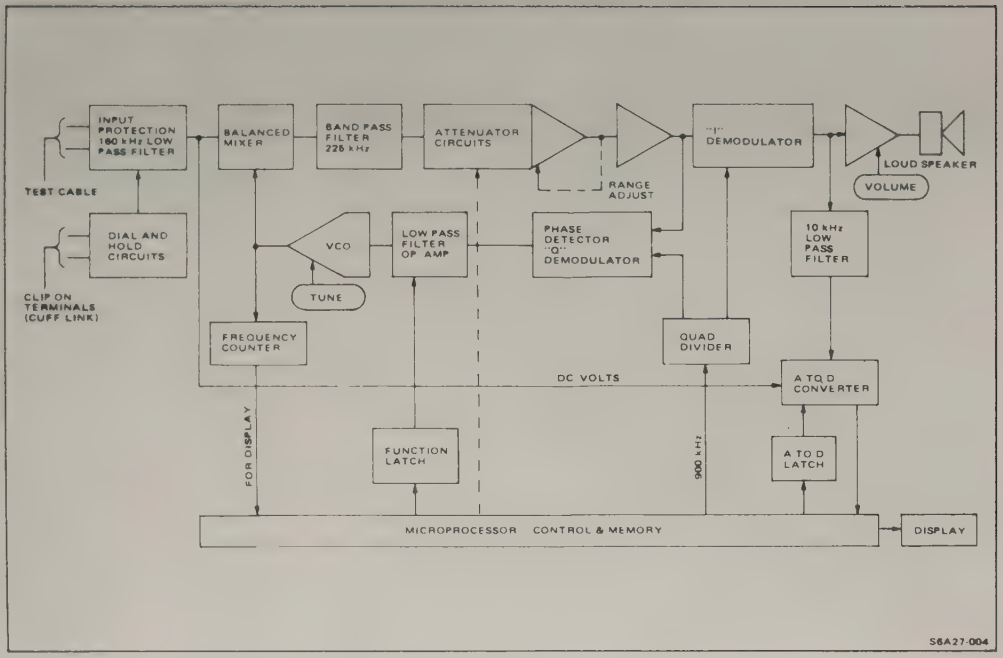


Figure 6. 306A Test Set Functional Block Diagram

3.03 The mixer/IF (phase-locked loop) is tuned to a desired incoming frequency by adjusting the local VCO (internal oscillator) frequency with the TUNE control. The IF output at 225 kHz is filtered and attenuated from 0 to 48 dB, in 6 dB steps, by a ladder attenuator. Stepping is accomplished by eight MOS switches, controlled by the microprocessor and referenced to the A to D converter output. The attenuator signal is then amplified, with a gain of approximately 60 dB at 225 kHz. The in-phase "I" demodulator output is applied to the A to D converter through a 10 kHz low pass filter and to an audio amplifier and the monitor loudspeaker. With the Function Selector switch set to the READ or LEVEL positions, the phase detector, or quadrature "Q" demodulator, output is used to lock-up the VCO—IF phase-locked loop when enabled at the low pass filter. If the VCO is tuned to within 500 Hz of a valid carrier frequency or VF tone, phase-lock will be achieved.

3.04 A to D converter circuitry consists of an integrator, a comparator and several analog switches controlled by the microprocessor. The A to D converter integrates the output of the band-pass setting, low pass filter (10 kHz) or the dc line voltage. It provides the digital data related to signal level, polarity and integrator offset to the micro-processor. DC voltage is measured linearly in the A to D converter.

3.05 Ranging circuitry is controlled by the micro-processor and will maintain a level within a 12 dB range. The gain of the attenuation circuits is shifted in 6 dB increments to minimize "range hunting".

3.06 The micro-processor controls all internal test set functions and sequencing for each measurement. It is used to encode the A to D and frequency outputs for display as well as determining ranging of the display and test circuits. The micro-processor also monitors the power supply and generates the signaling for low battery conditions.

4. OPERATION

4.01 The following paragraphs provide detailed instructions for the operation of the 306A Test Set.

RECEIVING INSTRUCTIONS

4.02 Unpack the test set and inspect it for signs of physical damage. If the test set is damaged or does not operate properly, ship the equipment prepaid to Anaconda Telecommunications; Anaheim, California.

POWER REQUIREMENTS

4.03 The test set is powered by ten, size–AA, nickel-cadmium batteries. These batteries may be recharged using the Anaconda external Transformer/Charger, Part No. 306B. Carbon-zinc or alkaline batteries may be used to power the test set; however, precautions must be taken to assure that the Transformer/Charger is not connected when they are installed.

WARNING

Carbon-zinc batteries cannot be recharged and must be discarded when the charge is depleted. Use of the Transformer/Charger with carbon-zinc batteries creates a serious hazard to personnel and to the test set.

4.04 Batteries, when purchased with the test set, are packed separately in the shipping carton. Install the test set batteries using the following instructions:

1. Set the Function Selector switch to the OFF position.

2. Remove the four captive screws from the rear cover and remove the cover.

CAUTION

Batteries must be installed in accordance with the polarity marking in the battery compartment. Improper installation results in non-operation of the test set.

3. Install the batteries in the battery compartment (Figure 7) observing the polarity markings on the terminal board.

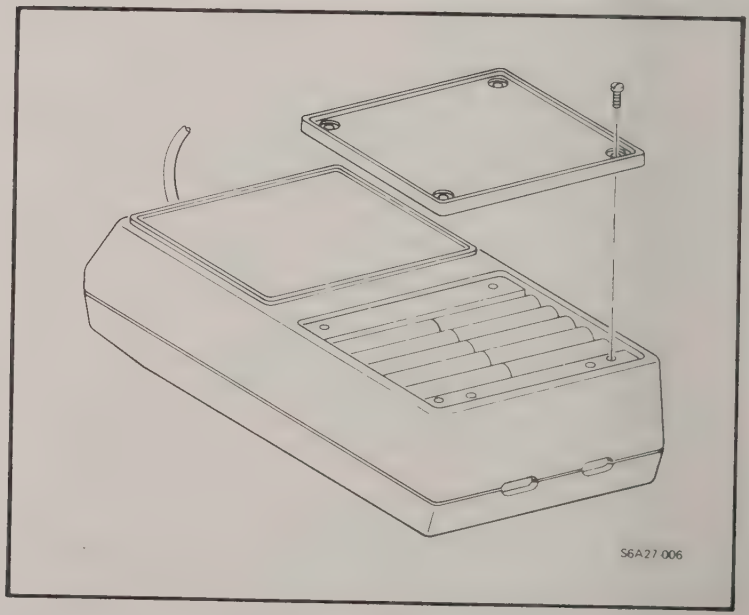


Figure 7. 306A Test Set Battery Installation

4. Reinstall the rear cover on the test set.

5. When using Ni-Cad batteries (AJ306D), it may be necessary to recharge them before using the test set. Simply insert the output plug of the Model 306B Transformer/Charger into the external jack (9, Figure 5), set the Selector Switch to OFF, and allow the charger to operate for one hour.

CARRIER LEVEL MEASUREMENT

4.05 The 306A Test Set contains a built-in cable with test clips for connecting to the carrier equipment or carrier line. Carrier level tests are made on new system installations to determine the level at a Subscriber Terminal, Repeater or CO Terminal to verify concurrence with predicted levels. Level tests made for maintenance purposes would validate the system to the previously determined or specified levels. Perform carrier level measurements using the following instructions:

1. Connect the test clips to the carrier line lugs at the terminal (CO or field side depending on input or output being measured).
2. Set the Function Selector switch to the CXR TUNE position (Figure 8).
3. Rotate the TUNE knob until the frequency corresponding to the channel under test appears in the display. Channel frequencies for the S6A Station Carrier System are listed on the back of the test set. Refer to other type Carrier System documentation for channel frequencies.
4. Set the Function Selector switch to the LEVEL position. The level of the carrier signal, in dBm, will appear in the display.

VOICE FREQUENCY (VF) MEASUREMENTS

4.06 The 306A Test Set is terminated across a 900-Ohm VF circuit when using the built-in cable and test clips. VF tests require the use of a dial handset which is connected through the 306A. The DIAL

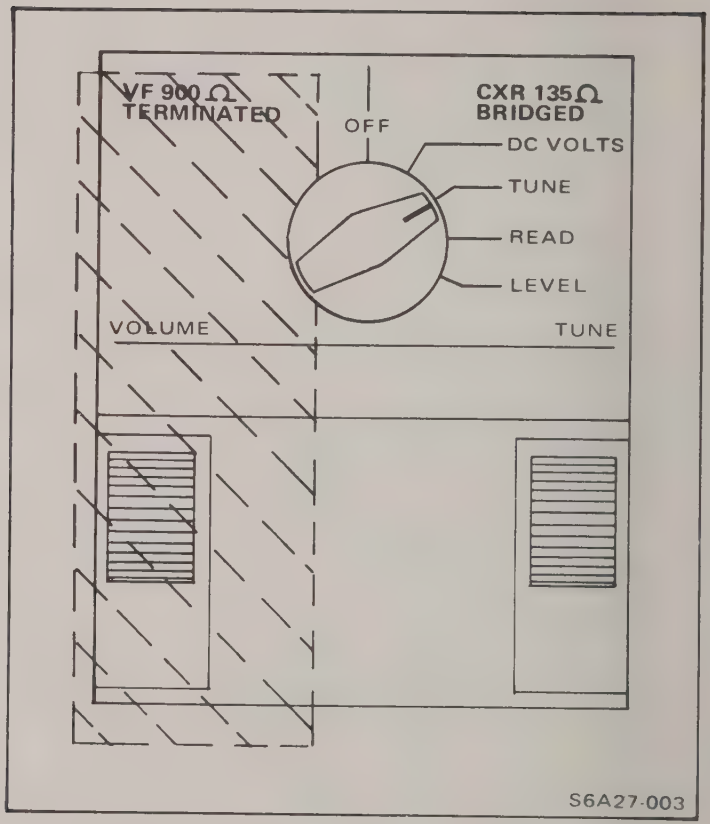


Figure 8. Carrier Frequency Measurement Settings

and HOLD feature holds a line and permits monitoring of either a standard test tone or "quiet" line. Perform 900-Ohm VF tests using the following

instructions:

1. Connect the 306A test clips to the "drop" lugs at the Subscriber Terminal or directly across the subscriber line.

NOTE

All equipment connected to the drop must be "on-hook" to assure accurate readings.

2. Connect the dial handset to the 306A through the clip-on (cuff-link) terminals on the lower end of the test set. (Figure 9).

Figure 9. Test set – Clip-on Terminals

3. Set the Function Selector switch to the DIAL position (Figure 10) and using the dial handset, dial a test number.
4. Set the Function Selector switch to the TUNE position on the VF side of the test set.

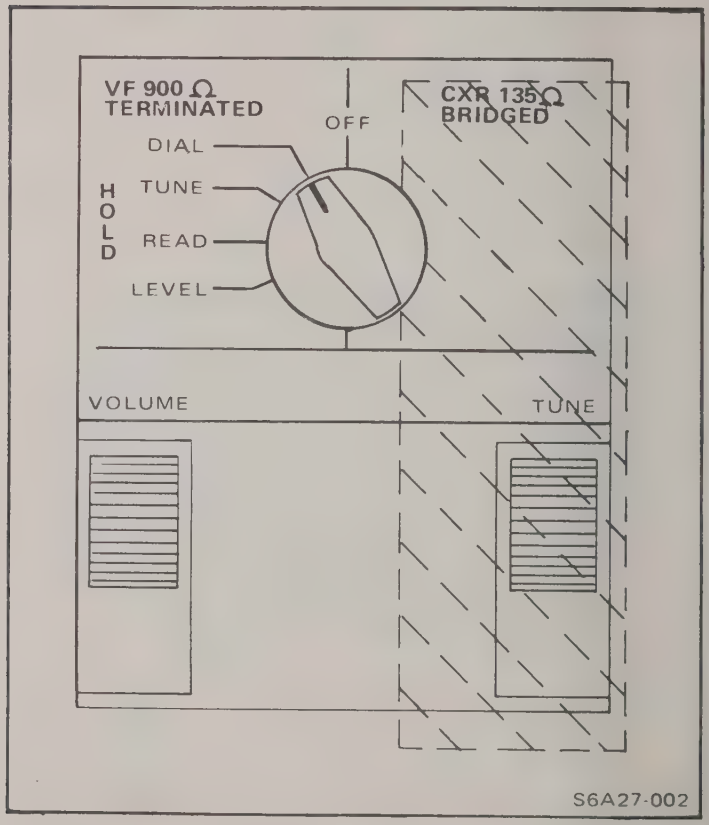


Figure 10. VF Measurement Settings

5. Rotate the TUNE knob until the frequency to be measured appears in the display.
6. Set the Function Selector switch to the READ position and the actual frequency being monitored will appear in the display.
7. Set the Function Selector switch to the LEVEL position. The level of the VF signal will appear in the display.

DC VOLTAGE MEASUREMENT

4.07 The operating voltage for the carrier system is supplied from the CO Terminal (and a Remote Power Supply in extended range applications) and distributed to the remote terminals and Repeaters via the carrier line pair.

Perform the DC Voltage measurements using the following instructions:

1. Set the Function Selector switch to the OFF position.

NOTE

Voltage measurements are usually made "Tip to Ring" but to assist in failure analysis, may be made "line to line" or "line to ground". Voltage levels shall be as specified for the particular type system under test.

2. Connect the test set to the line under test.
3. Set the Function Selector switch to the DC VOLTS position. The voltage level will appear in the display.

AUDIO MONITORING

4.08 Audio modulation on carrier signals may be monitored using the built-in loudspeaker. To use the loudspeaker, rotate the VOLUME control knob and adjust for a suitable listening level. Audio monitoring in

VF measurement may be used to detect and identify the type and magnitude of idle line noise. When tuning a carrier, the beat frequency will be audible and can be used for "zero-beat" tuning.

CAUTION

For maximum battery life, keep the VOLUME control in the minimum position. Continuous use of the Audio Monitor will considerably reduce battery life.

5. MAINTENANCE

5.01 Operator maintenance on the 306A Test Set is limited to cleaning of the unit and battery replacement. Anaconda recommends that service and calibration be performed at the nearest Regional Repair Center or at the factory. If additional information is required, contact the Anaconda Customer Service Department.

CAUTION

The 306A Test Set case is made of a plastic material. Solvents should be avoided. The use of excessive amounts of alcohol may soften the adhesives on the front panel and instruction decal.

CLEANING

5.02 Normal cleaning of the 306A Test Set exterior should be done with detergent and a damp cloth. Heavy grease deposits may be removed by a cloth dampened with denatured alcohol.

6. SPECIFICATIONS

CARRIER FREQUENCY LEVEL MEASUREMENT

Carrier Tuning Band	5 kHz to 152 kHz
Tuning Accuracy	±20 Hz
Display Accuracy	Nearest 10 Hz
Measurement Range	+9.9 dBm to –49.9 dBm
Measurement Accuracy	± 1 dB (Including Bridge Loss)

INPUT LOADING

Maximum Composite Power Level	±13 dBm
Bridge Loss	<0.2 dB (at 20 kHz)
AC Input Impedance	>4 k-Ohm, calibrated to 135-Ohm readings

CARRIER DEMODULATION (AUDIO OUTPUT)

Harmonic and Intermodulation Distortion	–40 dB (referenced to composite power level)
Audio Level	Audible at 3 feet

VOICE FREQUENCY MEASUREMENT (TEST TONE)

Test Tone Frequency (Tune)	800 Hz to 15 kHz
Tuning Accuracy	±20 Hz
Display Resolution	10 Hz
Display Resolution	0.1 dB
Input Impedance	900 Ohm ± 10%

VOLTAGE MEASUREMENT

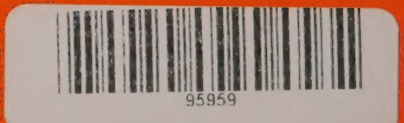
Voltage Range	0 to ±350 Vdc
Accuracy	±5%
Input Impedance	>100k-Ohms
Display Resolution	0.1 Volt (Auto-Polarity)

POWER REQUIREMENTS

Batteries	10 nickel-cadmium rechargeable size AA cells
Voltage	12 Vdc
Charge Life (Nickel-Cadmium)	4 hours continuous use, up to 8 hours intermittent use
Battery Charging	External Transformer/Charger (306E) through external charger connector
Alternate batteries	Carbon-zinc batteries may be used but must never be recharged

ENVIRONMENT—PHYSICAL

Temperature (Operating)	0 degrees C to +50 degrees C
(Storage)	−40 degrees C to +60 degrees C
Input Circuit Protection	
Lightning	600V Transient (10us rise, 1200us decay)
Ringing	110V rms, 20 Hz (Biased at ±42 Vdc)
Maximum Continuous dc	500 Vdc
Enclosure	High Impact Molded Plastic
Dimensions	
Length	10 inches
Width	4.5 inches
Depth	2.25 inches
Weight	<4 lbs.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